Introduction

The *Power Plant Improvement Initiative*, the U.S. Government's first major competition for industry-proposed clean coal technology demonstration projects since 1992-93, attracted 24 candidate projects by the April 19, 2001, proposal deadline.

In the FY 2001 appropriations for the Department of Energy's Fossil Energy technology programs, the U.S. Congress provided $95 million from prior year Clean Coal Technology funds for the *"commercial scale demonstration of technologies to assure the reliability of the Nation's energy supply from existing and new electric generating facilities."*

The Department issued its call for proposals on February 6, 2001.

The proposed projects, with sites identified in 15 states, have a total value of $535 million, the requested federal share of which would be just over $251 million. Winning projects are scheduled to be selected in August 2001. Proposers will be required to at least match the federal share of project funding.

In its call for proposals, the Department requested applicants to prepare a brief abstract of the proposed project that could be made available to the public. This document compiles the public abstracts received from the applicants.

Power Plant Improvement Initiative

Project Proposals

Proposer / Point of Contact	Project Title/Demonstration Location	Page #
Allegheny Energy Supply Monroeville, PA William C. Guyker Phone: 412-858-1107	Coal Gasification as an Emission Reduction and Plant Improvement Technique Site: Willow Island, WV	7
Alliant Energy Corporation Madison, WI Joseph J. Pieters Phone: 608-250-6802	Combustion Initiative for Innovative Cost-Effective NO_x Reduction Sites: Sheboygan, WI and Portage, WI	8
ALSTOM Power Inc. Windsor, CT John Marion Phone: 860-285-4539	Combined Power and Cement Production - High Efficiency Electricity and Cement Co-Production by Innovative Clean Coal Technology Site: LaSalle, IL	9
Arthur D. Little, Inc. Cupertino, CA Renee Wong Phone: 617-498-5655	Development of Hybrid FLGR/SNCR/SCR Advanced NO_x Control for Orion Avon Lake Unit 9 Site: Avon Lake, OH	10
Coal Tech Corporation Merion Station, PA Dr. Bert Zauderer Phone: 610-667-0442	Low Cost, Combined Control of SO_2 and NO_x in Coal Fired Utility Boilers Site: Not designated in proposer's Public Abstract	11
CONSOL Energy, Inc. South Park, PA F. P. Burke Phone: 412-854-6676	Greenidge Multi-Pollutant Control Project Site: Torrey, NY	12
Control Components Inc. (CCI) Rancho Santa Margarita, CA Stuart A. Carson Phone: 949-858-1877	Efficiency Improvement Through the Use of Advanced Final Control Element Technology Site: Not designated in proposer's Public Abstract	13
EcoLink Houston, TX Upendra W. Singhe Phone: 281-497-1483	ARC System for Enhancement of Power Plant Efficiency and Decrease in Air Emissions by Improving the Steam Cycle Resulting in Increased Thermal Efficiency Site: Not designated in proposer's Public Abstract	14
e-SCRUB Systems Incorporated Alexandria, VA Dr. Maija Harkonen Phone:703-836-1761	e-SCRUB^{tm} Treatment Facility Demonstration for H.T. Pritchard 260 MWe Generating Station Site: Martinsville, IN	15

Proposer / Point of Contact	Project Title/Demonstration Location	Page #
Gas Technology Institute Des Plaines, IL Mary Ann Edgell Phone: 847-768-0759	Aventis Integrated Gasification Combined Cycle Power Project Site: Institute, WV	16
Great River Energy Underwood, ND Charles Bullinger Phone: 701-442-7001	Lignite Fuel Enhancement Site: Underwood, ND	17
Intellergy Corp. Berkeley, CA Dr. Terry R. Galloway Phone: 510-841-9774	SIUC Waste-to-Energy Project Site: Carbondale, IL	18
McDermott Technologies, Inc. Alliance, OH E.L. Davison Phone: 330-829-7617	Thoroughbred Ultra Low Emissions Project Site: Muhlenberg County, KY	19
Otter Tail Power Company Fergus Falls, MN William Swanson Phone: 605-862-6300	Demonstration of a Full-Scale Retrofit of the Advanced Hybrid Particulate Collector Technology Site: Big Stone City, SD	20
Phenix Limited, LLC Oxnard, CA Keith Moore Phone: 805-985-1545	The Clean Combustion System Repowering Demonstration for Low-Cost Control of SO_2 and NO_x Emissions from Coal-Fired Utility Boilers Site: Marion, IL	21
Pittsburgh Mineral & Environmental Technology, Inc. New Brighton, PA William Sutton Phone: 724-843-5000	Supercritical Water (SCW)-Enhanced Combustion Site: Joseph City, AZ	22
Silverado Gold Mines, Inc. Fairbanks, AK Ed Armstrong Phone: 907-479-7014	Construct and Operate a Low-Rank Coal-Water Fuel Production Plant at the Grant Gold Mill on Ester Dome, AK Site: Ester Dome, AK	23
Southern Research Institute Birmingham, AL Nancy Thompson Phone: 205-581-2625	Sustained Use of Coal Through Biomass Cofiring Site: Southern Company Services Site to be determined	24
Sunflower Electric Power Corp. Hays, KS Wayne E. Penrod Phone:785-628-2845	Achieving New Source Performance Standards (NSPS) Emission Standards Through Integration of Low-NO_x Burners with an Optimization Plan for Boiler Combustion Site: Garden City, KS	25

Proposer / Point of Contact	Project Title/Demonstration Location	Page #
Tampa Electric Co. Tampa, FL Robert N. Howell Phone: 813-228-1932	Polk Power Station Plant Improvement Project Site: Mulberry, FL	26
Tampa Electric Company Tampa, FL Robert N. Howell Phone: 813-228-1932	Tampa Electric Company, Big Bend Power Station, Neural Network-Sootblower Optimization Site: Apollo Beach, FL	27
Universal Aggregates, LLC South Park, PA David C. Kay Phone: 412-854-6762	Commercial Demonstration of the Manufactured Aggregate Processing Technology Utilizing Spray Dryer Ash Site: Birchwood, King George County, VA	28
Xcel Energy Minneapolis, MN Daniel S. Bernt, PE Phone: 612-330-1947	Bay Front Power Plant Unit 5 Emissions Control and Fuel Optimization Site: Ashland, WI	29
Xiong Cheng-Rui P.R. China Phone: 0086-312-502-3904	An Igniting and Self -Stabilized Pulverized Coal Burner Site: Not designated in proposer's Public Abstract	30

Power Plant Improvement Initiative

Project Abstracts

Allegheny Energy Supply Monroeville, PA William C. Guyker Phone: 412-858-1107	Coal Gasification as an Emission Reduction and Plant Improvement Technique Site: Willow Island, WV

Public Abstract: Allegheny Energy Supply Co., LLC proposes to design, construct, test and demonstrate mild gasification/producer gas-based reburn technology at its Willow Island Generating Station. In this project, coal from the coal pile will be diverted from the main coal supply to the power plant and gasified in a mild gasification system. The producer gas generated from this system, containing ~140 Btu/ft3 of chemical energy and fired at ~1500^{0}F, will be fired as reburn gas in #2 boiler. This boiler is a 188 MWe cyclone boiler fired with washed Pittsburgh Seam coal. The char from the gasifier, a calcium-rich source of carbon containing >9300 Btu/lb, will be cooled and returned to the coal supply. It will be burned in the cyclones. While gasification has been demonstrated previously, and rebum technology for NOx control has been demonstrated previously as well, this combination has not been designed or tested to date. it represents a significant step forward in developing cost-effective NOx reduction technology for existing cyclone and pulverized coal boilers. It is a technology with no effluents since the gas is burned in the boiler, the solid products of gasification --char-- are also burned in the boiler, and no waste liquids or solids are generated for disposal. The project can be integrated with the current sawdust/tire-derived fuel designer opportunity fuel cofiring demonstration for the co-gasification of biomass and coal. The objectives of this research include demonstrating the application of coal gasification at existing power plants to achieve advanced NOx control. The objectives also include achieving combustion improvements in the cyclone boiler and gasification system improvements including the potential of cogasification of coal and opportunity fuels from biomass. Long term, the demonstration will provide a basis for studying the use of gasification chars as a product feedstock.

The methodology for the program is to begin with Phase I, a detailed design including gasifier selection, process design, modeling and reburn system design, and then discipline engineering to produce the necessary drawings, specifications, and related documents sufficient to construct the system. In Phase II, the system will be constructed at the Willow Island site in an area adjacent to the power house. In Phase III the system will be continuously tested to demonstrate the NOx reduction of producer gas-based reburn in a cost effective and technically efficient manner.

Allegheny Energy Supply Co., LLC. – owner of the Willow Island Generating Station – is the program sponsor and it has assembled a significant team to execute the project. Allegheny will manage the project. N.S. Harding and Associates of Salt Lake City will lead the process engineering phase, supported by Reaction Engineering International. Fairfield Engineering will provide the discipline engineering. Foster Wheeler Energy Corporation will serve as project consultant throughout the entire process and will manage the test program. Each organization has committed significant senior staff to the project. This staff is uniquely qualified; further it has experience working together on other projects at the Willow Island Generating Station. In summary, Allegheny Energy has developed and is proposing a simple yet advanced concept for enhanced NOx control and combustion at Willow Island; and has brought together sufficient qualified resources to implement that proposal and achieve the objectives of USDOE Solicitation DE-PS26-01NT41104 in a highly effective manner.

Alliant Energy Corporation Madison, WI Joseph J. Pieters Phone: 608-250-6802	Combustion Initiative for Innovative Cost-Effective NO_x Reduction Sites: Sheboygan, WI and Portage, WI

Public Abstract: Alliant Energy's Combustion Initiative is a science-and-technology—driven approach to lowering emissions and improving the performance of coal-fired power plants. Through research and development, the company is finding innovative ways to reduce emissions, increase thermal efficiency, and improve plant reliability.

The Combustion Initiative is a methodology that starts with developing a deep understanding of the combustion and related processes in each piece of equipment and in the power plant as a whole. The second step is to push the envelope for existing NO_x control technologies through re-engineering and modeling. The use of computational modeling as a tool is key to optimizing the system performance and maximizing the use of emission reduction technologies. The Combustion Initiative methodology results in the potential to reduce NO_x emissions to 0.15 lb NO_x /mmBtu or below, without the use of selective catalytic reduction (SCR) technology, and at a fraction of the capital cost and at much lower O&M costs. The ability to reach these low NO_x emission levels has been demonstrated in the pilot-scale work that Alliant Energy has conducted at its M.L. Kapp Station in Iowa.

Alliant Energy proposes, through its Wisconsin Power & Light Company subsidiary, to demonstrate the reduction of NO_x emissions using the Combustion Initiative methodology on three of the main coal-fired boiler types in the United States: T-fired, cyclone-fired, and wall-fired units. The three units include Edgewater Generating Station Unit 4 (cyclone) and Unit *5* (wall-fired) in Sheboygan, Wisconsin, and Columbia Generating Station Unit 2 (T-fired) in Portage, Wisconsin. Reduced emissions are directly in line with the company's commitment to improving the environment for everyone. Better thermal efficiency will mean that less fuel will be needed to produce energy, which saves money and reduces stress on equipment. Improved reliability will help keep customers' lights on, even as demand grows throughout the region. Finally, when costs are minimized, shareowners will experience increased earnings. Through applied science and technology, the Combustion Initiative is helping Alliant Energy find cost-effective solutions to challenges the Power industry faces today and tomorrow.

ALSTOM Power Inc. Windsor, CT John Marion Phone: 860-285-4539	Combined Power and Cement Production - High Efficiency Electricity and Cement Co-Production by Innovative Clean Coal Technology Site: LaSalle, IL

This project will demonstrate a new and novel, power and cement co-production technology at a commercial scale in an existing cement plant located in LaSalle, Illinois, owned by Illinois Cement Company. Co-production of power and cement creates process synergies that translate into significant improvements that directly respond to the DOE Power Plant Improvement Initiatives.

The proposed project will produce 40 MW~ of power, of which approximately 25 MW~ will be exported to the Illinois electric grid. In addition, the project will enable co-production of an additional 350,000 tons per year of cement production (-•- 60% increase). This demonstration will show a cost competitive increase in reliable power production, improved efficiency, and a significant reduction in gaseous and solids emissions. For example, this technology enables nearly 100% utilization of coal combustion solid by-products. This demonstration project meets the overall goals of the DOE Power Plant Improvement Initiative to improve coal-based electricity reliability and security in the U.S.

This project will be accomplished in a joint venture with three large US corporations; ALSTOM Power, Inc., Illinois Cement Company [parent company: Centex Construction Products, Inc.], and American Electric Power Energy Services Co. These partners will provide 40% of the total funding of this project, plus significant additional costs to develop this project and investment in plant capital to enable this project. ALSTOM Power, inc. is the world's largest manufacturer of power generation equipment, and is the sole owner of the Combined Power and Cement process. As the crucial step towards commercialization of this process, ALSTOM Power is organizing the proposed demonstration project. Illinois Cement is the owner of the La Salle, Illinois cement plant that is currently producing 600,000 tpy of cement with a single pre-heater kiln. Illinois Cement's interest is to increase cement production by 350,000 tpy to meet current market needs; they are also interested in the increased efficiency and decreased power costs that will result from the project. American Electric Power Energy Services (AEP group) is interested in participating in the project for the sale of electricity (40 MW~ peak, 200,000 MW-hr/yr).

In addition, the State of Illinois, Department of Commerce and Community Affairs (DCCA), is strongly interested in this project to promote the clean and economic use of high sulfur Illinois coal, and has offered to provide a funding grant equal to 20% of the total project.

The Combined Power and Cement technology offers the both industries attractive performance and economics, and near term market deployment. The Combined Power and Cement technology will be a significant contributor to the continued environmentally acceptable use of coal.

Arthur D. Little, Inc. Cupertino, CA Renee Wong Phone: 617-498-5655	Development of Hybrid FLGR/SNCR/SCR Advanced NO_x Control for Orion Avon Lake Unit 9 Site: Avon Lake, OH

Coal-fired power boiler operators are facing a dual challenge to remain competitive while adapting to deregulation and to impending stringent NOx controls. The NOx control technologies available to coal-fired operators are not optimized for this new set of challenges. Under deregulation, the optimum control techniques need to have a low capital cost base, and cost basis, and cost effective reduction over a wide operational range so that the performance of each unit in the system can be optimized to allow maximum revenue dispatch. The increased flexibility is needed to allow each boiler and the integrated system to respond competitively to market conditions. Current reliance on selective catalytic reduction, with the associated high capital cost, will not typically give a utility sufficient dispatch flexibility to maximize competitiveness. As an alternative, the team of Acurex Energy, Fuel Tech and Orion Power are proposing development and demonstration of a hybrid system of lower cost components that can be operated separately or as an integrated, optimized single control.

The three components in the hybrid system are FLGR/SNCR, SNCR, and compact SCR. The three components have been developed individually, but have not been developed and optimized as a hybrid control. The objectives of this project are to demonstrate the hybrid as a lower cost alternative to SCR to achieve 0.15 lb/MMBtu emission levels, and to operate the hybrid system to improve performance and reduce compliance costs to enhance operation in system-wide dispatch in the deregulated market.

The hybrid system will be installed on Orion's Avon Lake Unit 9 boiler near Cleveland, Ohio. This is a 623 MW wall-fired unit firing eastern bituminous coal. Acurex Energy will perform the engineering and conduct the performance testing. Fuel Tech will supply the system hardware for the FLGR, SNCR and SCR modules. The system will be retrofit in February 2003 and tested and optimized during the 2003 ozone season. Long-term performance and emission monitoring will be done during the 2004 ozone season.

Coal Tech Corporation Merion Station, PA Dr. Bert Zauderer Phone: 610-667-0442	Low Cost, Combined Control of SO_2 and NO_x in Coal Fired Utility Boilers Site: Not designated in proposer's Public Abstract

Low cost coal supplies over 50% of the nation's electricity, yet current power plant construction overwhelmingly favors costly natural gas. This is due in part to the high cost of current coal emission controls for nitrogen oxide, NOx, and sulfur dioxide, SO2, and concern over future additional controls. In the past several years, Coal Tech's internally financed R&D has developed several very low cost NOx and SO2 control processes. Their unique features are: Extremely low equipment cost, installation in a matter of hours without the need to modify or shutdown the boiler, and ability, especially in combination, to achieve very low emissions of SO2 and NOx. The NOx reduction technology consists of a staged combustion process, a non-catalytic reduction process, and a reburn process using oil or biomass. They were developed in extensive testing in Coal Tech's commercial scale, 20 million Btu/hour combustor boiler facility in Philadelphia. Each of the NOx processes reduces emissions by at least 40%to 50%, and in combination by up to 90% from 1 lb per million Btu to less than 0.1 lb per million Btu, which is below EPA's 2003 NOx regulation of 0.15 lb/MMBtu. The combined SO2/NOx process has yielded as much as 80% reductions for each effluent. The non-catalytic NOx process and the SO2/NOx process were briefly tested on three coal fired utility boilers, where the NOx results obtained in the small facility were duplicated.

The objective of the present proposal is to implement a more extensive validation of Coal Tech's low cost NOx and SO2 control processes on utility boilers. From a national database a group of boilers that are representative of the U.S. installed capacity will be selected as candidates for these tests. From this group, four boilers will be selected for testing, with preference given to those that can benefit from the permanent installation of NOx and SO2 control equipment. Validation tests of the each of the NOx and SO2 control processes will be implemented. This will be followed by designs for permanent installation of the control equipment, which could be implemented at the conclusion of the tests. These NOx and SO2 processes can be rapidly installed throughout the U.S. because they are independent of the boiler design, and in most cases, will not require any boiler modifications, or even shutdown. The last feature is ideal for preventing shutdown of power plants that have reached annual emission limits. A measure of Coal Tech's confidence in this technology is our offer to provide 50% of the project costs from internal resources.

CONSOL Energy, Inc. South Park, PA F. P. Burke Phone: 412-854-6676	Greenidge Multi-Pollutant Control Project Site: Torrey, NY

CONSOL Energy Inc., AES Greenidge LLC, Environmental Elements Corporation (EEC), Foster Wheeler Energy Corporation (FWEC), and AEP Pro Serv, propose to install and test an integrated multi-pollutant control system on the 104 MW AES Greenidge Unit 4. The 4.5-year project would be the first to demonstrate:

- NOx emissions less than 0.122 lb/MM Btu using a single-bed, in-duct Selective Catalytic Reduction (SCR) unit, in combination with low-NOx combustion technology, on a unit firing coal and biomass
- SO_2 removal of 95% using EEC's Circulating Dry Scrubber (CDS) on a unit firing >2% sulfur bituminous coal
- Mercury reduction of 90% by the addition of activated carbon into the CDS
- Acid gas (SO_3, HCl, HF) removal greater than 95% in the CDS

Greenidge Unit 4 is representative of 492 coal-fired electricity generating units in the United States with capacities of 50-300 MWe. These smaller units, almost one-quarter of the U.S. coal-fired generating capacity, are increasingly vulnerable to fuel switching or retirement as a result of more stringent state and federal environmental regulations. The proposed project will demonstrate the commercial readiness of an emissions control system that is particularly suited, because of its low capital and maintenance costs, to meet the requirements of this large group of smaller existing electricity generating units.

The single-bed, in-duct SCR, in combination with low-NOx combustion technology, can achieve 60% NOx reduction for about one-third the capital cost and one-fourth the operating and maintenance cost of a full SCR or Selective Non-Catalytic Reduction (SNCR) system on a 100 MW unit. The capital cost of the CDS system is projected to be less than half that of a conventional flue gas desulfurization (FGD) system on a 100 MW unit. Operating and maintenance costs are less, and reliability is better for the CDS system, because it is less mechanically complex than a conventional FGD. Activated carbon injection into the CDS unit is projected to use 5 to 10 times less carbon than direct injection into flue gas duct for a given level of mercury control, because the carbon has a greater average contact time in the CDS bed than in the flue gas duct. Reducing the carbon feed rate results in substantial mercury control cost savings. The CDS system will reduce acid gases (SO_3, HCl, HF) by more than 95%, with the additional benefits of reducing plume visibility and secondary particulate formation. Acid gases must be reported to EPA as part of the Toxic Release Inventory (TRI). The project will also include an evaluation of the impact of biomass co-firing (5-10% of the boiler fuel) on the performance of the SCR and CDS systems.

The goal of the proposed project is to demonstrate substantial improvements in mercury, SO_3 and fine particulate control, and substantial reductions in the cost for NOx and SO_2 control, compared to conventional technologies when applied to the large number of smaller coal-fired generating units in the U.S. This project will produce operating and maintenance cost data, reliability and availability data, and process performance data so that generators will accept the risk of installing for multi-pollutant control on smaller coal-fired units. Ultimately, the successful demonstration of these technologies will help to ensure the future availability of low-cost electricity from a significant fraction of the U.S. coal-fired generating fleet.

Control Components Inc. (CCI) Rancho Santa Margarita, CA Stuart A. Carson Phone: 949-858-1877	Efficiency Improvement Through the Use of Advanced Final Control Element Technology Site: Not designated in proposer's Public Abstract

Public Abstract: This proposal aims to demonstrate technology that can improve performance of the existing coal-fired power plants by 3 to *5%.* These improvements are expected in the following areas: (1) reliability, (2) efficiency (heat rate), (3) maximum megawatt capacity, and, (4) reduction in emissions on a "per MW" basis.

We propose to demonstrate the improvements by focussing on control valves and on valve-related systems. This area has traditionally been neglected in the context of achieving reliable peak power plant performance. However, the early results from work that has been done to date indicates that this avenue holds tremendous potential for gain in power plant performance. No other changes are anticipated to the rest of the power station, as far as control loop tuning or the piping or the steam cycle or the combustion side, to achieve such gain. Therefore, there would be practically no risk to applying this technology in existing power stations and it can be done in conjunction with any other programs that the station may want to pursue.

We propose to partner with Tennessee Valley Authority (TVA) on this project. The concept will be demonstrated in full-scale in three different types of boiler Units — drum-type, once-through sub-critical Unit and supercritical Unit. These three basic types of power stations represent more than 95% of the bigger fossil power plants (> 100 MW) in the U.S. and the world today. The project will have three broad phases: (1) study of the power station systems and establishing a reference for current performance, (2) implement changes, and, (3) Monitor the improvements and report. It is expected that the project can be completed in two years, taking this concept to maturity.

With 300,000 MW produced by coal-fired power stations in the U.S., improvement of even 3% in performance, is equivalent to a gain of 9000 MW if applied across the board. This technology can be applied to other conventional fossil powered power stations. Incorporating the lessons from this project when building new power stations will make them inherently more reliable and more efficient.

EcoLink Houston, TX Upendra W. Singhe Phone: 281-497-1483	ARC System for Enhancement of Power Plant Efficiency and Decrease in Air Emissions by Improving the Steam Cycle Resulting in Increased Thermal Efficiency Site: Not designated in proposer's Public Abstract

Public Abstract: No Public Abstract was submitted.

e-SCRUB Systems Incorporated Alexandria, VA Dr. Maija Harkonen Phone:703-836-1761	e-SCRUB^{tm} Treatment Facility Demonstration for H.T. Pritchard 260 MWe Generating Station Site: Martinsville, IN

Public Abstract: The DOE Power Plant Improvement Initiative (PPII) recognizes: - the necessity to rely on fossil fuels for a major share of our electricity needs; - that coal has a place in a diverse mix of energy resources; and - that affordable ways to utilize coal while meeting stringent environmental standards are required. A major goal of the PPII is also to demonstrate viable technologies with potential for immediate commercial replication that enhance the reliability and improve economics of the coal based electric power system in the US.

Electron processing has been an established industrial process in the US since about 1950. The simultaneous removal of SO_2 and NOx from flue gasses by electron scrubbing has been developed and refined since the process was invented at the Japan Atomic Research Institute in 1970. Previous studies, initiatives, evaluation reports and pilot demonstrations always concluded that the process is technologically feasible. However, even with recent developments in the electron scrubbing process, and with commercial installations overseas, US utilities are reluctant to consider this combined SO2 and NOx control technology that exhibits high efficiency with salable byproduct as a viable option.

Objectives of this project are to demonstrate the performance and operational cost of the patented e-SCRUB^{TM} process, an advanced, US-based, high-efficiency, multi-pollutant control, electron-scrubbing technology in light of the PPII Funds from DOE, e-SCRUB Systems and Indianapolis Power & Light Co. (IPL) will be used to install the e-SCRUB^{TM} proccss on a commercial scale, gage performance to NSPS, indicate reliability and determine economic viability. e-SCRUB's pro forma and business plan indicates that the combined emissions-control technology is an attractive option and marketable to a significant number of aging and smaller coal-fired power generating plants. The host-site offers an ideal situation and location to prove the current process, reduce emissions, utilize the by-product, increase generation capacity, improve economics, maximize fuel flexibility and continue the useful life of an existing coal-fired facility.

Two new ID fans shall be installed in the first phase of the project to minimize generating unit outage time. The fans shall be sized to overcome the pressure drop associated with prior electrostatic precipitator retrofits and excess air-in leakage. Larger ID fans should allow IPL to recover a 9 MWe station capacity derate, and increase system reserves.

Two trains of e-SCRUB^{TM} equipment will be installed to treat 100% of the flue gas from 4 coal-fired boilers at IPL's H. T. Pritchard Station located southwest of Indianapolis. The e-SCRUB^{TM} process includes, a spray dryer, dry electrostatic precipitator, ammonia injection, electrons, wet electrostatic precipitator, and a brine re-circulation system designed to capture 98% of the SO_2 & SO_3, up to 95% of the NOx and 99.9% of the PM 2.5 (fine particulate) emissions from the station. The process is to also produce a salable high-grade ammonium sulfate and ammonium-sulfate-nitrate fertilizer by product to offset reagent cost.

Gas Technology Institute Des Plaines, IL Mary Ann Edgell Phone: 847-768-0759	Aventis Integrated Gasification Combined Cycle Power Project Site: Institute, WV

Public Abstract: The goal of the Power Plant Improvement Initiative (PPII) is to facilitate demonstration of advanced technologies that are near commercial and that will benefit national energy security by improving reliability of electricity supply. Technologies must demonstrate superior environmental performance and efficiency compared to existing commercial technologies. The Calla Energy Partners, LLC project to be located at Institute, WV, meets all of these goals, and provides an excellent opportunity to demonstrate the use of coal gasification technology. They are developing an ACFB project for replacing the old steam boilers of the Aventis Chemical Complex in Institute, WV with new equipment to supply their steam and electrical needs.

Gas Technology Institute (GTI) will team with Calla EP, Carbona (GTI's licensee), Nexant, a subsidiary company of Bechtel, and General Electric (GE) to install a gasification combined cycle system (IGCC) to combine with their ACFB facility. This unit will provide additional steam and electricity generation capability to the facility at a superior efficiency to that provided by the ACFB boilers alone. The IGCC system is based on using GTI's U-GAS® coal gasification technology and General Electric's GE10 gas turbine. The project team proposes to install a GE10 turbine that yields approximately 14.7 MWe (11.2 MWe on natural gas) output. A heat recovery steam generator (HRSG) will generate the equivalent of an additional 5 MW of steam for sale. The IGCC facility is approximately 50% more efficient than the 80 MWe ACFBs to be installed at the Aventis Complex. The inclusion of the IGCC will improve plant efficiency, reduce emissions and improve overall reliability of energy supply to the Aventis site. Plans also include use of the ACFB to reduce the sulfur dioxide emissions from the IGCC. The combination of these two technologies will increase the use of coal at the facility by approximately 150 tons/day. The key aspects of the project to be demonstrated are:

- Demonstrate LCV Combustion an industrial scale gas turbine
- Demonstrate the use of coal in for distributed generations systems that improve the reliability of the local utility's electrical distribution and transmission system
- Demonstrate the superior efficiency possible in a gas turbine by burning hot fuel gas
- Demonstrate the superior NOx emissions possible with LCV gas compared to natural gas
- Demonstrate the ability to design gasification systems for modular replication at an industrial scale
- Demonstrate the superior efficiency of IGCC systems compared to modern coal fired industrial scale boilers

Great River Energy Underwood, ND Charles Bullinger Phone: 701-442-7001	Lignite Fuel Enhancement Site: Underwood, ND

Public Abstract:

Project Goal and Objectives

The goal and objective of this project is to significantly enhance the value of lignite as a fuel in electrical generation power plants within the next 5 years. Although current lignite power plants are designed to burn high-moisture coals (about 40%), a reduction in moisture content of 5 to 15 percentage points (about one quarter of the moisture content in the coal) will result in significant improvements.

All fossil steam plants reject large quantities of heat in the cooling water used to condense steam. Engineering studies at Great River Energy (GRE) Coal Creek Station show that this waste heat could be used to lower the moisture content of the coal by at least 10 percentage points (or one quarter of the moisture in the coal). Remarkably, very few applications for this low-level waste heat have ever been demonstrated. Use of this technology will translate into the following benefits for the U.S.:

- Increasing the net generating capacity of units that burn high-moisture coal.
- Increasing the new energy supply of units that burn high-moisture coal.
- Increasing the cost-effectiveness of the nation's electrical generation industry.
- Improving the environment by reducing emissions from coal-fired plants.
- Increasing the value of the nation's lignite reserves.

The cost benefits from improved plant performance, reduced emissions, and increased availability far out weigh the cost of drying the fuel. This work represents a potential landmark advance of fossil-steam plant performance improvement, emissions reduction and plant availability and is also applicable to Powder River Basin sub bituminous and biomass high moisture fuels as well.

Methodology

The benefits of reduced-moisture-content lignite will be demonstrated at the GRE Coal Creek Station in Underwood, North Dakota. A phased approach will be used. Design studies of coal drying system alternatives will be evaluated and a single design for pilot-scale testing will be selected before progressing to full-scale demonstration in the second phase. The optimum moisture content will be validated in frill-scale operational testing before progressing to performance optimization in the third phase.

Intellergy Corp. Berkeley, CA Dr. Terry R. Galloway Phone: 510-841-9774	SIUC Waste-to-Energy Project Site: Carbondale, IL

Public Abstract: This project will complete a conceptual design for an energy production system that will make use of an old coal burning power plant without air pollution controls. The new plant will demonstrate the renewable and sustainable technologies of the future, produce valuable middle distillates for an adjacent refinery, accept community industrial and hospital waste, and produce electrical power at the lowest rate prior to privatization while eliminating the emission of greenhouse gases. This project will demonstrate the use of an advanced steam refortning/gasifier to process a mixture of local coal and waste using a combined-cycle fuel cell! turbo-electric system to generate power at a very high efficiency of 68 to 74%. This conceptual design will be used to complete a economic feasibility analysis that will justify that this advanced waste-to-energy plant will have a simple payback period around 3 to 5 years. With both the conceptual design and the economic analysis completed for two scales: 20 and 200 MWe, a feasibility report will be written that will be used by the community to obtain financial commitments from local industry, the Carbondale Business Development Corp., the State of illinois, AMEREN Corp., and Federal agencies to move forward with Phase 2 of the project to prepare construction drawings and Phase 3 with the coal integrated gasification fuel cell combined cycle power plant construction beginning in two years from start of project Phase 1.

McDermott Technologies, Inc. Alliance, OH E.L. Davison Phone: 330-829-7617	Thoroughbred Ultra Low Emissions Project Site: Muhlenberg County, KY

For two decades our nation has experienced declining electric generating margins. Energy demand continued to increase and decision-making transitioned into the new regime of deregulated energy supply, leading to heavy reliance upon natural gas for new generation. Current natural gas based electricity prices and supply reliability issues underscore that our nation must not continue to depend almost solely on natural gas for its new generation. With improved environmental capabilities recently attained and others still emerging, coal is destined to resume an important role in new utility generation. This proposed Power Plant Improvement Initiative (PPII) project will be a highly significant milestone in the resumption of new coal-fired generation. While attaining economic viability, the proposed Thoroughbred Ultra-Low Emissions Project (TULEP) will produce outstandingly low emissions -- the lowest emissions levels of any coal-fired power plant in the world.

Peabody Group has announced plans to build two 750 MW units that will burn high-sulfur Kentucky coal at its Thoroughbred Energy Campus in Muhlenberg County, Kentucky. Initial operation is scheduled for 2004-2005. One of those units, supplied by Babcock & Wilcox Company, will be equipped with advanced emission control technologies as part of a highly efficient coal-fired power plant -- TULEP. The three key demonstration project objectives are:

1. With an array of advanced technologies, attain simultaneously lower emissions levels of NOx, SOx, particulate, including condensable acid gases (H_2SO_4, HCl and HF — addressing $PM_{2.5}$ and regional haze), and mercury than those attained at any other coal-fired generating facility in the world; and demonstrate the interdependencies (both positive and negative) among the various emission control subsystems.

2. Ensure that the capital cost for utilizing the advanced technologies and associated operating costs are not significantly different than the costs for commercially available technologies today.

3. Improve electricity reliability locally and regionally by achieving 85% or higher capacity factors and a commercial level of availability beginning with the first year of commercial operation, which is unique for new technologies.

The array of B&W technologies to be demonstrated in TULEP will be applicable in whole or in part to other coal-fired plants, for both new generating units and retrofit applications. TULEP will be a showcase for addressing our nation's electricity supply reliability, price stability, and energy security issues.

Otter Tail Power Company Fergus Falls, MN William Swanson Phone: 605-862-6300	Demonstration of a Full-Scale Retrofit of the Advanced Hybrid Particulate Collector Technology Site: Big Stone City, SD

Public Abstract: A new concept in particulate control, called an advanced hybrid particulate collector (AHPC), is being developed under funding from the U.S. Department of Energy. The AHPC combines the best features of electrostatic precipitators (ESPs) and baghouses in an entirely novel manner. The AHPC concept combines fabric filtration and electrostatic precipitation in the same housing, providing major synergism between the two methods, both in the particulate collection step and in transfer of dust to the hopper. The AHPC provides ultrahigh collection efficiency, overcoming the problem of excessive fine-particle emissions with conventional ESPs, and solves the problem of reentrainment and re-collection of dust in conventional baghouses.

A slipstream AHPC (9000 scfrn) has been operating at the Big Stone Power Plant for the past 1½ years. The AHPC demonstrated ultrahigh particulate collection efficiency for submicron particles and total particulate mass. Collection efficiency was proven to exceed 99.99% by one to two orders of magnitude over the entire range of particles from 0.01 to 50 μm. The flue gas exiting the AHPC was as clean as pristine ambient air with a fine particulate matter level of 5 $\mu g/m^3$. This level of control would be well below any current particulate emission standards. These results were achieved while operating at significantly higher air-to-cloth ratios (12 ft/min compared to 4 ft/min) than what is used for standard pulse-jet baghouses. In fact, preliminary economic analysis of the AHPC compared with conventional ESPs and baghouses indicates that the AHPC is economically competitive with either of these technologies for meeting current standards. For meeting a possible stricter fine-particle standard or 99.99% control of total particulate, the AHPC is the economic choice over either ESPs or baghouses by a wide margin.

The AHPC is a superior technology not only for new installations but as a retrofit technology as well. The AHIPC combines a high particulate collection efficiency, with a small footprint and potential economic advantages. Given the age and performance level of many existing ESPs, there is a great and immediate need for this type of retrofit technology.

Therefore, Otter Tail Power Company and its partners, Montana-Dakota Utilities and NorthWestern Public Service, is proposing to retrofit the AHIPC technology into an existing ESP structure at the Big Stone Power Plant. The overall goal of the project is to demonstrate the AHPC concept in a full-scale application. Specific objectives are to demonstrate ultralow fine particulate emissions, low pressure drop, overall reliability of the technology and, eventually, long-term bag life.

Phenix Limited, LLC Oxnard, CA Keith Moore Phone: 805-985-1545	The Clean Combustion System Repowering Demonstration for Low-Cost Control of SO_2 and NO_x Emissions from Coal-Fired Utility Boilers Site: Marion, IL

Public Abstract:

OBJECTIVES

The Clean Combustion System™ (CCS) simply prevents the formation of both SO_2 and NO_x emissions when firing the high-sulfur Midwest coals. The proposed full-scale CCS demonstration on a utility boiler will provide the coal and utility industry a fresh low-cost option to repower or retrofit coal-fired electrical generating stations to comply with the stringent Clean Air Act Amendment environmental rules.

METHODOLOGY

The CCS is a simple innovative entrained-flow combustion system (similar to an air-blown coal gasifler) with combustion air staging. The CCS replaces the boilers existing coal burners with a refractory lined gasification/burner section. The coal, pulverized with limestone additives (calcium) for sulfur capture, is conveyed to the CCS burner by air. The CCS high temperature gasification process captures the coal's sulfur with the calcium and removes it from the hot gas along with the coal ash. The ash is an inert glassy slag. Simultaneously, No_x (and the precursors of NO_x) are converted to harmless molecular nitrogen. The clean hot gases then exit the CCS into the boiler furnace. As the gases cool and generate steam in the boiler, overfire air is staged to avoid the formation of new (thermal)NO_x and complete the combustion of the gasified coal. The only chemical needed for SO_2 and NO_x control is limestone. An electrostatic precipitator captures the fly ash downstream of the boiler.

Pittsburgh Mineral & Environmental Technology, Inc. New Brighton, PA William Sutton Phone: 724-843-5000	Supercritical Water (SCW)-Enhanced Combustion Site: Joseph City, AZ

Public Abstract: The proposed project is entitled "Supercritical Water (SCW) Enhanced Combustion" and is sponsored by Pittsburgh Mineral and Environmental Technology, Inc. (PMET), located in New Brighton, Pennsylvania. The demonstration will be conducted at the Cholla Power Plant Unit No. 1 of Arizona Public Service located in Joseph City, Arizona. The proposed technology, trade named "Proteus", has been under development for the past several years and shows great promise at accomplishing the goals of the Power Plant Improvements Initiative in increasing efficiency, increasing cost effectiveness and decreasing emissions from coal-fired power plants.

The Proteus System, is a proprietary system for the purposes of improving the conversion efficiency of coal into electricity and transforming a power plant's fly ash waste stream into a saleable by-product. Proteus involves the introduction of supercritical water into a coal-fired power plant boiler in order to enhance the combustion of carbon. The removal of the carbon from the fly ash assists in making the fly ash a saleable byproduct as a cement additive rather than a waste stream requiring disposal.

The objectives of the project are to establish the following at commercial scale: (1) the ability of the technology to accomplish nearly complete oxidation of carbon with a resulting increase in thermal output; (2) reductions of NOx and SOx as the water vapor combines with NOx and SOx to form nitrous and sulfurous acids which condense onto the surfaces of ash particulates due to differences in tribo-electrical potential; (3) decreases in CO2 per unit of thermal output due to the increased power plant efficiency and from the utilization of fly ash as a cement additive thus avoiding production of Portland cement which creates I ton of CO2 for each ton of cement produced; and (4) power plant operating cost improvements due to the enhanced thermal efficiency and the avoidance of fly ash disposal costs.

The Proteus technology has been developed with the assistance of engineers from Arizona Public Service where the phenomenon which has evolved into the Proteus technology was originally noted. Design engineering and pilot scale testing has been directed by R.W. Beck, Inc. Marketing of the resulting low carbon fly ash will be performed by Essroc Cement, who has also been active in the development of the Proteus technology.

Silverado Gold Mines, Inc. Fairbanks, AK Ed Armstrong Phone: 907-479-7014	Construct and Operate a Low-Rank Coal-Water Fuel Production Plant at the Grant Gold Mill on Ester Dome, AK Site: Ester Dome, AK

Public Abstract: The Alaskan Low-Rank Coal-Water Fuel (LRCWF) Project is designed to demonstrate the economic feasibility of commercial production and use LRCWF made from hydrothermally treated Alaskan subbituminous coal in an oil-designed boiler and a diesel engine. The initial experimental work, completed in 1991, was performed at the University of Alaska Fairbanks (UAF) and the Energy and Environmental Research Center, University of North Dakota. The US Department of Energy (DOE), the Alaska Science and Technology Foundation (ASTF) and UAF provided funding. Initial work showed that a clean-burning, low-fouling LRCWF could be produced from Alaska's Beluga coal deposit located near Cook Inlet and marketed competitively in Japan. The next step required for commercialization is a demonstration-scale production facility.

In 1997 the A. D. Little, Inc. (ADL) team that had been awarded funding to demonstrate coal-water fuel (CWF) in a diesel electric generating (DEG) system in the last round of the DOE Clean Coal Technology Program lost their host utility site. After lengthy discussions with the LRCWF development group, ADL proposed resiting the project to the University of Alaska Fairbanks (UAF) and using LRCWF as diesel fuel. DOE approved the revised program and agreed to provide up to half of the $48 MM for an Alaskan LRCWF—Diesel Demonstration at UAF.

In order to better match DOE cost share requirements the diesel engine was ordered and construction of the DEG facility was begun, while work on the LRCWF facility was deferred after completion of the detailed design of the LRCWF plant. Cost overruns in the construction of the DEG facility of over 100% have left a project shortfall of over $16 MM, if the LRCWF plant is built at UAF. Without the LRCWF plant there will be no tests of CWF in the UAF diesel engine and the opportunity to develop commercial Alaskan LRCWF plants will be lost.

Without an infusion of significant additional funding, there appears to be only one way to complete the project and fulfill project obligations to DOE and ASTF; and that is to move the LRCWF production plant into an existing facility in the private sector. This will eliminate building a costly new facility and make use of an existing facility with much of the required equipment already in place. A private sector site, near UAF, with much of the required equipment already in place, was found -- Silverado Gold Mines Inc.'s gold recovery plant at their Grant Mill on Ester Dome, Alaska.

Silverado has formed a LRCWF production team with the expertise and experience necessary to successfully construct and operate the LRCWF plant at the Grant Mill in a timely, cost-effective manner. LRCWF team members are: Silverado Gold Mines Inc. -Owner of the Grant Mill; Coal Water Fuel Services - Primary developer of LRCWF production and utilization technology, which has entered into an exclusive agreement to provide the technology through Silverado; Great Northern Engineering - Engineering firm that designed the LRCWF plant with CWFS; and the Mineral Industry Research Laboratory (MIIRL) UAF.

Southern Research Institute Birmingham, AL Nancy Thompson Phone: 205-581-2625	Sustained Use of Coal Through Biomass Cofiring Site: Southern Company Services Site to be determined

Public Abstract: Biomass cofiring offers a significant improvement for coal-fired power generation: potentially 20% less fossil carbon and 20% more kWh of generation from a coal-fired power plant for a given amount of coal input. In addition, reductions in 502 and NOx emissions have been quantified: SO_2 reductions are proportional to the percentage of coal displaced, and NOx emissions may be reduced by an equivalent amount depending on cofiring specifics. As with any technology that reduces the production of these pollutants, biomass cofiring should also improve plant availability by reducing the demand on components of the plant normally used to control the emission of these pollutants. In light of the national push for increased power plant availability and capacity, it is prudent for utilities to evaluate cofiring as a part of their fuel selection decision. This technology also offers a way for the coal-based power industry to become a major provider, perhaps the largest provider, of renewable energy in the US within 10 years.

Although the reduced production of pollutant gases with biomass cofiring is predictable, measurable, and represents tangible environmental benefits, there remain technical problems and unknowns that are bafflers to implementation in the coal-fired utility sector. A major impediment to widespread biomass cofiring is the inherent material handling problem caused by the low bulk density and morphology of biomass. A second factor is the uncertainty of the effects of the chemical constituents of the flue gas and ash produced from biomass cofiring on boiler operation and maintenance costs. This project is designed to identify and optimize solutions to these technical hurdles. The project will begin with a survey of existing biomass resources to identify the prime candidates for cofiring installations. The project participants will perform technical evaluations and economic analyses that will evaluate and optimize methods for preprocessing biomass feedstocks so they can be handled and fired without requiring significant changes in power plant equipment or procedures. Also, the project will model the long term effects of biomass cofiring on ash deposition in the boiler, measure the corrosion effects of biomass cofiring with EPRI's unique corrosion monitor, and characterize the ash produced through biomass cofiring to clear the way to the use of non-coal fly ash as a cement additive.

Energy and economic budgets and models will be developed for each biomass fuel options investigated in these studies. These results will be used to implement a full-scale evaluation of an optimized biomass cofiring configuration at one of the Southern Company's power plants. At the conclusion of this full-scale evaluation, the project will have produced a recipe by which a majority of the nation's coal-fired power plants will have the option of employing reliable, low-cost, environmentally friendly biomass cofiring technology.

Sunflower Electric Power Corp. Hays, KS Wayne E. Penrod Phone:785-628-2845	Achieving New Source Performance Standards (NSPS) Emission Standards Through Integration of Low-NO_x Burners with an Optimization Plan for Boiler Combustion Site: Garden City, KS

Public Abstract: Low-NOx Burners (LNB) have been in development since the late 1970's and are in general use on many steam-electric generating units. Increasing demands for overall reductions in nitrogen oxide (NOx) emissions have continued to put pressure on manufacturers to improve burner design. Recent developments have introduced what are generally referenced as ultra-LNB. When used with separated over-fire air (SOFA) they have been found capable of reducing emission rates very near the current new source performance standard (NSPS) level of about 0.16 pounds per million British thermal units (mmBtu).

The purpose of this project is to research and install the very best of the ultra-LNB available and, further, to install with them other new features all directed to enhancing the control of NOx during combustion to annual emission rates of about 0.13 or 0.14 lbs/mmBtu. Naturally, vendors are reluctant to guarantee emissions at or below the NSPS level. A practical demonstration of the best designed and controlled equipment will reduce the uncertainties and thus assure the availability of technology that has much lower installed cost than the Selective Catalytic Reduction (SCR) units that are now in favor. A portion of the technology proposed has been installed on one 600 MW wall-fired unit and it has achieved the NSPS level of NOx emissions, at least on a short-. term basis.

The full application of the five-elements proposed herein have never been demonstrated in plants tiring sub-bituminous coals, especially those from Wyoming's Powder River Basin (P RB). Likewise, there are no other wall-fired units on which owners have sought to fully explore the technology proposed to it's fullest potential. The inclusion of the very latest in distributed control systems, proposed for this unit in 2003, make this location ideal for integration with the proposed elements. The unit on which this technology will be applied has among the very best availabilities and performance histories for boilers of its type. It was placed in commercial operation in 1983 and is equipped with the latest sulfur-dioxide (SO2) scrubber and fabric filter for particulate matter. When completed, this will be among the cleanest non-SCR equipped coal-fired units in the United States.

We believe there are as many as 30 units onto which this technology can be deployed that will be able to meet the current NSPS level, if long-term practical demonstration can be made. A further 60 units will be able to establish significant reductions, to levels of about 0.22 lbs/mmBtu. This choice of equipment, if enabled in a timely fashion, will allow a reduction in the number of SCRs being installed, thereby reducing the overall consumer cost; will reduce the outage duration necessary for completion, thereby improving the electric system reliability; and will conserve the critical manpower needed to accomplish this work, which is now in such short supply. Overall, some improvements in operating efficiencies are certain for this proposed unit, but the complexity of evaluating those on a fleet basis is beyond the scope of this proposal. The existing conditions on the proposed unit are such that additional capacity and energy may be generated with the addition of this equipment. While this condition may exist elsewhere, it also is beyond the scope of this proposal.

Tampa Electric Co. Tampa, FL Robert N. Howell Phone: 813-228-1932	Polk Power Station Plant Improvement Project Site: Mulberry, FL

Public Abstract: Coal is our nation's most abundant fuel resource. It is used primarily in power plants. However, coal contains up to 60% more carbon per unit of useful energy than liquid fuels or natural gas, so coal fired power plants are normally large sources for C02 generation and by-product source.

A new type of coal fired power plant called Integrated Gasification Combined Cycle (IGCC) has been developed, demonstrated, and commercialized in the United States and abroad. In IGCC plants, the coal is first converted into a high-pressure gas before combustion. Conventional pollutants and their precursors such as sulfur, nitrogen compounds and particulates are much easier to remove from this high pressure low volume gas stream in IGCC plants than from the low pressure high volume combustion products in power plant stacks. IGCC demonstration plants funded in part by the United States Department of Energy (DOE) under the Clean Coal Technology Program have already shown their environmental superiority in this regard. At this time, Polk Power Station is generating 250 MW (Net) of power, is operating at over 80% availability and is one of Tampa Electric Company's premier baseload plants. This same attribute of IGCC plants, a high-pressure low volume gas stream, which contains most of the fuel's carbon, also offers the best chance to minimize the cost and demonstrate CO_2 capture and recovery. The Polk Power Station project also offers an opportunity to demonstrate the full recycling of all coal streams from the gasification process. Within the gasification process, the ability to measure the wear pattern of the brick liner will also be demonstrated to increase unit reliability and availability including extended life. Tampa Electric's Polk Power Station which was placed in-service September 30, 1996 with over 25,000 hours of run time on the gasifier, provides the platform for demonstrating this project.

Phase I will include the complete process design and preliminary engineering. Phase II will consist of the detailed engineering and long lead-time equipment. Phase III will cover construction, startup, operation/demonstration and reporting of the results and conclusions.

The demonstrations proposed herein for the Polk Power Station will provide significant improvements to overall plant performance, plant reliability and plant operating costs thereby assuring the gasification technologies remain competitive for future power generation applications.

Tampa Electric Company Tampa, FL Robert N. Howell Phone: 813-228-1932	Tampa Electric Company, Big Bend Power Station, Neural Network-Sootblower Optimization Site: Apollo Beach, FL

Public Abstract: Cost effective generation of electricity is vital to the economic growth and stability of this nation. To accomplish this goal a balanced portfolio of fuel sources must be maintained and established which not only addresses the cost of conversion of these energy sources to electricity, but also does so in an efficient and environmentally sound manner. Conversion of coal as an energy source to produce steam for a variety of systems has been a cornerstone of modern industry. However, the use of coal in combustion systems has traditionally produced unacceptable levels of gaseous and particulate emissions, albeit that recent combustion, removal and mitigation techniques have drastically reduced these levels.

On such problem that exists with the combustion of coal, is the formation and deposition of ash and slag within the boilers which adversely affects the rate at which heat is transferred to the working fluid, which in the case of electric generators is water/steam. The fouling of the boiler leads to poor efficiencies due to the fact that heat which could normally be transferred to the working fluid remains in the flue gas stream and exits to the environment without beneficial use. This loss in efficiency translates to higher consumption of fuel for equivalentiievels of electric generation, hence more gaseous emissions are also produced. Another less obvious problem exists with fouling of various sections of the boiler relating to the intensity of peak temperatures within and around the combustion zone. Total NOx generation is primarily a function of both fuel and thermal NOx production. Fuel NOx which generally comprises 20%-40% of the total NOx generated is predominately influenced by the levels of oxygen present, while thermal NOx which comprises the balance is a function of temperature. As the fouling of the boiler increases and the rate of heat transfer decreases, peak temperatures increase as does the thermal NOx production.

Due to the composition of coal, particulate matter is also a by-product of coal combustion. Modern day utility boilers are usually fitted with electrostatic precipitators to aid in the collection of particulate matter. Although extremely efficient, these devices are sensitive to rapid changes in inlet mass concentration as well as total mass loading. Traditionally, utility boilers are equipped with devices known as sootblowers, which use, steam, water or air to dislodge and clean the surfaces within the boiler and are operated based upon established rules or operator's judgement. Without extreme care and due diligence, excursions or excessive soot can overload an ESP resulting in high levels of PM being released.

The intent of this project is to apply a neural network intelligent sootblowing system in conjunction with state-of-the-art controls and instruments to optimize the operation of a utility boiler and systematically control boiler fouling. This optimization process is targeted to reduce total NOx generation by +30, improve heat rate by 2%, and reduce PM emissions by 5%. As compared to competing technologies, this could be an extremely cost-effective technology, which has the ability to be readily and easily adapted to virtually any pulverized coal boiler.

Universal Aggregates, LLC South Park, PA David C. Kay Phone: 412-854-6762	Commercial Demonstration of the Manufactured Aggregate Processing Technology Utilizing Spray Dryer Ash Site: Birchwood, King George County, VA

Public Abstract: Universal Aggregates, LLC proposes to design, construct and operate a lightweight aggregate manufacturing plant at the Birchwood Power Facility in King George, Virginia.

The project team consists of CONSOL Energy mc, P.1. Dick, Inc., SynAggs, LLC, and Universal Aggregates, LLC. The Birchwood facility will transform 115,000 tons per year of spray dryer by-products that are currently being disposed of in an off-site landfill into 167,000 tons of a usefttl product, lightweight aggregates that can be used to manufacture lightweight masonry blocks or lightweight concrete.

In addition to the environmental benefits, the Birchwood facility will create eight manufacturing jobs plus additional employment in the local trucking industry to deliver the aggregates to customers or reagents to the facility. A successful demonstration would lead to additional lightweight aggregate manufacturing facilities in the United States. There are currently twenty-one spray dryer facilities operating in the United States that produce an adequate amount of spray dryer by-product to economically justilj the installation of a lightweight aggregate manufacturing facility. Industry sources believe that as additional scrubbing is required, dry FGD technologies will be the technology of choice. Letters from potential lightweight aggregate customers indicate that there is a market for the product once the commercialization barriers are eliminated by this demonstration project.

Xcel Energy Minneapolis, MN Daniel S. Bernt, PE Phone: 612-330-1947	Bay Front Power Plant Unit 5 Emissions Control and Fuel Optimization Site: Ashland, WI

Public Abstract: The proposed project is related to performance improvement and capacity enhancement of Cyclone boilers while meeting the present and potential future emission requirements. Developed in the 1940's to burn coal grades that are not well suited for the pulverized coal (PC) combustion, the Cyclone boiler was designed to take advantage of:

- Lower fuel preparation capital and operating costs (crushers only)
- Smaller furnace, and
- Reduced convection pass fouling due to 60% less fly ash carryover than PC boilers

Cyclone boilers constitute a small but critical segment of power boilers that use coal as the primary fuel. Many of these plants are located in strategically significant power grids. Cyclone boilers have special fuel requirements because of their unique combustor design and combustion characteristics. Compounded by recent stringent emission requirements, the fuel selection presents technical and economic challenges normally not encountered with conventional PC boilers. Some Cyclone boilers are temporarily derated due to lack of availability and/or lack of a technical basis for selecting alternate coals or coal blends. Often known coals and coal blends do not meet the heat input requirements. Augmentation with higher BTU fuel such as petroleum coke, although technically feasible, often presents operational and emission control problems.

A comprehensive four-step program is outlined to address these issues unique to facing Cyclone boiler based coal fired units:

- Fuel Screening - Characterization, Evaluation and Selection
- Emission Control Technology Screening and Selection
- Demonstration Tests in relatively large full-scale units
- Technical and Economic Evaluation and Recommendations

Eastern bituminous, western subbituminous, lignite coals/coal blends augmented by petroleum coke will be included in fuel screening. The emission control system required will depend upon the sulfur content of coal/coal blend and the emission requirements. Emission control technologies included in the proposal are:

- Furnace limestone injection
- In-duct scrubbing with hydrated lime
- Dry scrubbing with lime slurry

The program will be carried out at the Bay Front Station, Unit *5* of Xcel Energy located in Ashland Wisconsin. This 35MWe unit with typical Cyclone boiler operating characteristics and problems is the ideal candidate to develop and demonstrate performance improvement measures outlined in this proposal. Data collected during the proposed test program will be beneficial in the scale-up of larger Cyclone boilers.

Xiong Cheng-Rui P.R. China Phone: 0086-312-502-3904	An Igniting and Self -Stabilized Pulverized Coal Burner Site: Not designated in proposer's Public Abstract

Public Abstract: In a coal-fired power plant, when a boiler starts up, the pulverized coal-air flow is not as easy to ignite as gas or oil, and as the temperature in furnace is very low, gas or oil must be used for heating the furnace during start-up. In addition, when boilers operate under low load, the furnace temperature decreases so that stable combustion cannot be kept. Gas or oil is also used to stabilize the combustion in the furnace. As the power demand varies in cycle within 24-hours in a day and within a week, a number of boilers must shut down in midnight or weekend and started up again in the morning or on Monday morning or operate under low load during that period. This is called cycling. Thus, a large quantity of gas or oil is expended on cycling.

To save the gas or oil expended in cycling, this proposer [1] applied Karlovitz's flame theory [2] [3] to pulverized coal worked out a burner, which can ignite pulverized coal-air flow and stabilize its flame by using simple electric heating with a small amount of energy consumption and without any assistance of gas or oil. A "Proof-of-Concept-Test" was successfully completed. In a power plant with full scale, the expected functions were obtained *[4][5][6].* However, it needs a further application test to make the burner applicable for boiler practice,

Not only can this burner save oil spent on cycling, the burner can stabilize the flame in the furnace from 0.0% to 100% coal-fired boiler load, avoiding flame failure. It will enhance the power plant operational reliability.

To complete the application test, the main research work is a practical one. It can be performed in a vintage boiler first and can get commercial benefit very soon.

More important significance of the burner lies in that it can also burning low grade coal including anthracite and coke on existing and new pulverized coal-fired boilers, and controlling NOx/SO2 emissions and even meet the "Combustion 2000" goals of DOE.

Till now only boilers with Fluidized-Bed Combustors (FBC) can burn LGC and control NOx/SO_2 simultaneously well. However these FBC boilers have not formed a large scale for electric power generation, and research on FBC has expended a large amount of funds in the past two decades.

The proposed work will work out a simpler and better and cheaper way of burning LGC and controlling, NOx/ SO2 emission simultaneously than FBC.

As this burner has a high and unique flame stability. It will be helpful to develop other advanced combustion technology, for example, the limestone injection into furnace for capturing S02 and getting a chemical product calcium sulfate.

As this burner is for pulverized coal use, and pulverized coal is and will be the main fuel for power generation and will be used continuously in DOE's "Combustion 2000" coal-related R&D program, and according to available information there has been no such a pulverized-coal burner which has such an excellent multi-function as the proposed burner has. So this burner will have a long viability in commercial applications.

Saving oil (low cost), enhancing reliability, burning low grade coal(low cost).and improving $NOx/S0_2$ control, all these meet closely the DE-PS26-0INT41104-Solicitation the Power Plant Improvement Initiative Program.